

## NAVY RESPONSE TO EPA Review of and Comment to the 31 July 1997 Site 3 Work Plan Addendum

### GENERAL COMMENT 1:

In addition to the proposed monitoring wells, the addendum calls for the sampling of eleven existing monitoring wells. One of the bases for selecting these wells is to use the data to evaluate the occurrence of natural attenuation at the site. As stated in previous reviews related to this investigation, there are at least four fundamental conditions that must be present to confirm that processes contributing to natural attenuation are taking place. These include, but are not limited to:

- the points of sampling must be on flow lines from the source of contamination or at an up gradient point of observation.
- there must be a reduction in contaminant mass.
- site geochemistry must assure that conditions are right for reduction such as the presence of electron acceptors, state of redox, etc., and
- daughter products of contaminants must be present, perhaps with indicators of mineralization.

All of the above fundamental conditions can be evaluated with previously collected data and the proposed additional sampling, with the exception of reduction in contaminant mass. This fundamental condition for natural attenuation evaluation is complicated at this site due primarily to the confirmation of multiple sources; making it difficult to perform any type of mass balance on the plume and attributing reduction rates to natural attenuation. So while analysis of the groundwater data to be collected during this proposed sampling event may indicate that geochemical conditions are favorable, and appropriate daughter products have been documented, the confirmation of natural attenuation will only be documented qualitatively by evaluation of contaminant trends over time. Quantitative analysis of natural attenuation at this site may not be practical, due in part to the multiple sources and the possible presence of DNAPL.

The proposed investigation calls for the collection of analytical data necessary to evaluate whether conditions exist at the site which are favorable for the process of natural attenuation. This data includes the collection of specific field data during the sampling of the wells, of particular note is dissolved oxygen and eh. A review of the data collected during the December 1996 sampling indicated numerous inconsistencies in the field data which questions the validity of the data collected. There are many instances where a negative Eh is reported in the presence of significant dissolved oxygen concentration, i.e.  $Eh = -12.6$  and  $O_2 = 4.24$ . In one case the  $Eh = -52.7$ , while the  $O_2$  value is 46.3 mg/L. A DO of 46.3 mg/l is not possible. A supersaturated oxygen environment will have a dissolved oxygen near 20 mg/l. When you have an oxygen rich environment you can not have negative Eh values, however as seen above, this occurred in many instances. Additionally, in many cases negative DOs are given which is not possible.

It is recommended that during the performance of this investigation the Navy ensure that personnel knowledgeable in the relationships of these parameters be present to field validate the data as it is being collected. Such erroneous data likely indicates a problem with the instrumentation being used. Knowing which results are invalid at the time of collection can trigger an immediate response such as re-calibration of the instruments, etc in an effort to determine the source/reason for the readings and ensure quality data is being collected and the stated objectives being met.

As stated in our comment letter of April 18, 1997, the use of a down-hole probe to measure DO, pH, Eh, Temp & possibly conductivity is recommended since the last round of data indicated values that did not correspond to our paradigm of natural attenuation occurring at this site. The results from the last round of data showed some anomalous DO and redox measurements. The high DO may be due to the off-gassing into entrained air that was noticed during a previous audit in some of the meters and tubing, the effect of pumping the groundwater to the surface or the groundwater may indeed be highly oxygenated throughout the aquifer. Therefore, as a confirmatory step, dissolved oxygen, pH, Eh, Temp and conductivity should be measured at depth. This does not negate the need for the measurements to be made as part of the well stabilization determination required by the low flow sampling procedure. However, if DO and redox are also measured at the screened interval within the wells, the previous questions may be addressed.

#### RESPONSE:

The Navy agrees that not all of the DO and Eh readings collected during the December 1996 sampling event appear to correlate. In particular, EA agrees that O<sub>2</sub> concentrations as high as 46.3 mg/L are impossible without the use of oxygen releasing compounds or direct injection of pure oxygen. The value likely represents percent dissolved oxygen rather than concentration (mg/L) units, with the units being misread in the field. However, no negative DO results were reported for this sampling event. As agreed during the 11 September 1997 BCT meeting, the Navy will use the same methods to field measure DO and Eh as were used during the December 1996 sampling event so the data are comparable and so the water column in each well is not disturbed.

The Navy and EA also believe that reliance on DO and Eh data alone to estimate redox potential in the aquifer is not advisable. The method of collection for each parameter has its limitations. Some of the limitations for DO measurements that are brought about by the sampling method are discussed in the EPA comment. Eh measurements also have limitations. For example, Eh measures unique redox potentials which do not exist in natural waters, nor, typically, does a state of redox equilibrium (Chapelle, 1996). In addition, electrode-measured Eh values do not agree with values of measured redox couples and tend to decrease with time as a result of the accumulation of reduction products on the electrode. Therefore, too much confidence should not be placed on exact Eh values and measurement of redox pairs in conjunction with Eh has been suggested (Pankow, 1991).

EA and the Navy measured a host of information related to redox potential in December 1996 and believe that evaluation of all of this data and not a subset is necessary to provide a more accurate picture of the redox potential throughout the deep zone of the aquifer. This information included DO, Eh, redox pairs and  $H_2$  concentrations.  $H_2$  concentrations have been shown to provide an accurate indication of redox potential in some cases (Lovely and Goodwin, 1988; Chapelle et al., 1996). The Navy and EA believe that use of all of this data together provides sufficient information.

However, as EPA has pointed out and as is to be expected in any natural environment, not all of these data correlate perfectly. This is one reason that the Navy and EA have consequently proposed to recollect "natural attenuation parameters" from eleven existing wells. This second set of data will help confirm or refute the interpretation of the data made after the December 1996 sampling. These data are in addition to proposed VOC data, which as EPA has pointed out, can be used to show a reduction in contaminant mass, as well as the presence of daughter products, to support a natural attenuation case.

#### **GENERAL COMMENT 2:**

EPA appreciates the Navy's commitment to using geotechnical field techniques to help determine well placement in the northern part of the site. The location of the two lines of geophysical survey lines may need to be changed, based on a critical review of the existing geophysical survey lines. The Navy offers a generally sound approach towards siting the new wells along the northern perimeter of the site (i.e., wells A, B, C, D in Figure OS-1). However, the configuration of the two proposed seismic lines does not appear to offer the most advantageous geometry. Although the A, B, and C locations enjoy the benefits of a high density of seismic data, no seismic data is proposed for the D location. As an alternative, the Navy should consider extending the southernmost proposed seismic line to the west, beyond the EA-106 location. Also, in place of the proposed closely-spaced second east-west line, the Navy should consider extending former seismic lines C-C' and D-D' to the north. This would facilitate three-dimensional mapping of the subsurface in this important area of the site. The closely-spaced parallel lines offered in the current proposal have the risk of being redundant, not to mention the lack of control in the EA-106 area.

#### **RESPONSE:**

Location D is adjacent to existing monitoring well EA-106 which was based in part on interpretation of the seismic refraction geophysical data from Line CC' which extends to EA-106. Additionally, the proposed seismic refraction line along Perimeter Road will cross the end of the previous line DD'.

#### **GENERAL COMMENT 3:**

The goal of the proposed seismic work should be expanded to include identification and mapping of all potentially significant hydrostratigraphic units, e.g., till, weathered bedrock, competent bedrock, etc.

**RESPONSE:**

Interpretation of the previous seismic refraction data collected during the Phase III RI has typically estimated the interface between the unsaturated and saturated unconsolidated sediment and the top of competent bedrock. The top of till or weathered bedrock have typically not had a sufficient difference in velocity to be discerned. As has been done previously, the geological units that can be discerned will be shown in the geophysical report.

**GENERAL COMMENT 4:**

The proposed investigation strategy needs to be more explicit with reference to the weathered bedrock layer. The methodology selected must not only identify the "top of competent bedrock", but must also identify the top and thickness of any weathered bedrock horizons. At a minimum, this will involve collecting a greater length of core than is proposed (suggest 15 feet). More importantly, all attempts should be made to sample the materials present at the bedrock/overburden interface and underlying weathered bedrock, if present. Roller-bitting through this layer should be avoided. In addition, the sampling strategy in the overburden materials should call for the collection of a split-spoon sample at each change in stratigraphy, even if this is at a greater density than one sample for each 5 vertical feet of drilling.

**RESPONSE:**

Coring in weathered bedrock is not feasible. Sampling of weathered bedrock is also typically not feasible because the rock fragments do not fit in the VOA sample container and/or will not pack tight enough to mitigate voids in the sample container. However, because the screened interval of each "deep" monitoring well is planned to extend down to the top of competent bedrock (as stated in the work plan Addendum), ground-water samples are planned to be collected from the interval of concern, including weathered bedrock, if present. Additionally, as discussed during the 11 September 1997 BCT meeting, these planned additional monitoring well are anticipated to be compliance points for monitoring in the future and are expected to be nondetect for VOC.

**GENERAL COMMENT 5:**

The work plan should reference the specific QAPP section for both Sampling Analysis and Quality Assurance sections.

**RESPONSE:**

The October 1996 QAPP will be referenced.

**GENERAL COMMENT 6:**

Explanation/justification for monitoring well placement and selection of monitoring wells for the natural attenuation needs to be clarified. Since all wells to be sampled are within the plume, none are cross, or down gradient.

**RESPONSE:**

Justification for the selection of the eleven existing wells which will be sampled for VOC

and natural attenuation parameters is provided on Page 2, third full paragraph. The eleven wells include one upgradient well, six wells along the plume centerline, two cross gradient wells, one downgradient well and one well situated to confirm an interpreted or suspected methanogenic zone. The data from this planned sampling event are to confirm the previous data. Therefore, the samples are being collected from within various portions of the plume and plume edge; the collection of samples from outside the plume that would provide "ND" results would not be helpful.

New well locations were chosen to delineate the southern and northern extent of the plume. It is suspected that these wells will also be considered cross-gradient wells once the flow lines are drawn using the information from the wells.

**GENERAL COMMENT 7:**

Well MW01-14D does not constrain the down-gradient limit of the plume, it has breakdown products of TCE and therefore is not down gradient of the plume, it is on the leading edge of the plume. A new well, a downgradient well, should be placed downgradient along deep flow lines from MW01-14D and RW-01D and Allen Harbor. The deep flow lines may be advantageously determined through the use of drive point piezometers prior to deep well installation near Allen Harbor (approximately near former building 332 and the south eastern corner of the loop road shown on the figure 0S-1). Since there is no seismic control in this area, a geophysical survey should be initiated to map the top of till, and top of competent bedrock.

**RESPONSE:**

Only cis-1,2 dichloroethylene (DCE) was reported in a sample collected from well MW01-14D at a concentration of 2 µg/L. As discussed during the 11 September 1997 BCT meeting, the Navy believes that it is important to monitor this well at the leading edge of the plume to provide additional data to confirm plume extent at this well and to assess plume stability, rather than collecting data from wells further downgradient the would by their purpose provide "ND" results. Therefore, the Navy does not believe that additional wells downgradient of this well are justified.

**GENERAL COMMENT 8:**

As has been the practice in the past, prior to well installation, EPA expects the Navy to produce top of till, weathered bedrock and competent bedrock maps and deep groundwater flow maps for EPA and RIDEM review and should also set up a meeting, at least 1 week after BCT receipt of the maps, at the site to discuss well locations in the field.

**RESPONSE:**

The Navy has prepared top of competent bedrock and ground-water surface contour maps in the past and will continue to do so. Also, as in the past, the Navy will provide the results and interpretations of the geophysical study (refer also to the response to Comment 3). These data and maps will be provided for EPA/RIDEM review and discussion at a BCT meeting.

**GENERAL COMMENT 9:**

As the Navy has also done in the past, the screen location should be based on field GC analysis of the most highly contaminated soil.

**RESPONSE:**

The use of a field GC for previous work at the Nike Site was to confirm whether or not a monitoring well would be installed in the boreholes. Monitoring wells will be installed during the currently planned work as stated in the work plan Addendum. Therefore, the Navy will not be using a field GC for this work.

**GENERAL COMMENT 10:**

As noted in our April 18, 1997 letter, turbidity was not stabilized at some of the wells in the last round of measurements and therefore the data may not be representative of the aquifer conditions. The Navy should reevaluate the equipment used for sampling. EPA is willing to perform a field audit/sampling demonstration on the first day of sampling to insure the EPA Low Flow Sampling protocol is being implemented as it was intended. Please notify me a week in advance of start of field work so we can schedule around our expert's busy schedule.

**RESPONSE:**

As discussed during the 11 September 1997 BCT meeting, of the wells planned for sampling, only MW-Z3-3 and MW02-10D had elevated turbidity. The Navy will perform additional development of these wells prior to the ground-water sampling event. The Navy has collected samples at this site previously using the Low Flow Sampling during which there was various EPA oversight and audits. The Navy welcomes EPA's continued field oversight and audit representatives.

**GENERAL COMMENT 11:**

The Navy should also redevelop and re-sample the turbid wells to determine the reason for the high turbidity. The BCT should discuss the scope of this effort at the next BCT meeting.

**RESPONSE:**

Refer to the response to Comment 10.

**GENERAL COMMENT 12:**

Wells E & F seem to be located to determine the southern edge of the plume, however no explanation is included in the work plan. EPA is encouraged the Navy is looking toward the south to delineate the plume at this time. **Shallow** flow lines indicate that well E could be directly downgradient of the hot source area at MW03-14, but since the plume is at depth and bedrock may be a significant factor, the location of this well should be determined with the use of geophysical techniques and drive pont piezometers. MW-F seems to be located on a line connecting Z3-3 and Z4-1. Since there is no seismic control in the general vicinity nor have deep groundwater flow paths have been determined, it is recommended again that the Navy invest in geophysical techniques to map out the till and

bedrock units and use drive point push technology to determine deep flow paths prior to the installation of MW F.

**RESPONSE:**

As stated in the work plan Addendum objectives and in the second paragraph of page 2, these wells are planned to assess the southern edge (extent) of the plume. Additionally, these wells are planned to be compliance point wells, and therefore, are anticipated to be "ND". As discussed during the 11 September 1997 BCT meeting, the Navy will collect a round of water level measurements from the existing monitoring wells and piezometers (including PGU-Z3-05, -06, and -11) and prepare a related ground-water surface contour map for the "deep" wells for input to refinement of the selection of the Well E and F locations. Additionally, the Navy will include a seismic refraction survey line between the planned Well E and F locations also for input to refinement of the selection of the Well E and F locations.

**GENERAL COMMENT 13:**

While the deep zone has typically exhibited higher concentrations than the bedrock zone, it should be noted that relatively high concentrations have been detected in the bedrock zone in the vicinity of the NIKE site in rock wells MW03-14, MW03-13, and MW03-08. No other bedrock wells exist east or south of these wells which would define the extent of contamination in the bedrock in this direction. While two bedrock wells are proposed in the north, there are no bedrock wells to the south or east. This may be significant in establishing compliance points and for property transfer. It is recommended that bedrock wells be installed along with the deep wells proposed at E & F.

**RESPONSE:**

As agreed during the 11 September 1997 BCT meeting, the Navy will install rock wells at the E and F locations once the related "deep" wells are shown to be "ND". If they are not "ND", the location of the rock wells will be reassessed.

**SPECIFIC COMMENTS****SPECIFIC COMMENT 14. Page 2, Paragraph 4.**

This paragraph identifies the 11 existing wells proposed for sampling and provides rationale for the selection. These wells were selected presumably for continued evaluation of the occurrence of natural attenuation processes at the site. It is also recommended that monitoring wells RMW-01D and MW-Z4-1 be included. The property east of the plume is being considered for transfer to RIEDC. These wells may likely represent compliance point wells. These wells can be used to assess whether the contaminant plume is continuing to migrate to the east/southeast from contamination identified near monitoring wells MW02-11D and MW02-03D.

**RESPONSE:**

As shown in Figure OS-2 of the work plan Addendum, ground-water flow from MW02-11D and MW02-03D is toward the northeast, not southeast toward RMW-01D and MW-

Z4-1. However, as agreed during the 11 September 1997 BCT meeting, the Navy will include MW-Z4-1 in the ground-water sampling event, if the headspace measurements of the till soil samples from Well F are more than two times above the background PID measurement.

**SPECIFIC COMMENT 15. Page 3, Paragraph 1.**

This section provides rationale for the sampling of monitoring well MW01-12 stating "confirm the only interpreted methanogenesis zone". It is not evident from the previous data collected how the conclusion referring to a "methanogenesis zone" was derived. The most recent data (December 1996) sampling indicates an extremely oxygenated zone. Methanogenesis requires an extremely reducing environment, which is not substantiated by the last round of data. Further clarification is warranted.

**RESPONSE:**

As pointed out by EPA, DO (1.56 mg/L) and Eh (-29 mV) data from well MW01-12 do not suggest the reduced conditions necessary to support a methanogenic zone. However, DO data from the December 1996 sampling event was considered suspect for many of the reasons pointed out in the EPA comments to the Site 3 Work Plan Addendum. Therefore, more weight was given to other data collected during that sampling round to develop an idea of the redox potential in the vicinity of this well. Hydrogen concentrations (5.1 nmol/L) were indicative of a methanogenic zone, but methane concentrations (<0.01) were not. To resolve these apparent inconsistencies, the Navy and EA have proposed to resample this well.